WTE&TE - Mathematics instruction, problems, challenges and opportunities: a case study in Manokwari Regency, Indonesia

By Rully Charitas Indra Prahmana

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Mathematics instruction, problems, challenges and opportunities: a case study in Manokwari Regency, Indonesia

Benidiktus Tanujaya†, Rully C.I. Prahmana‡ & Jeinne Mumu†

Universitas Papua, Papua Barat, Indonesia†
Universitas Ahmad Dahlan, Yogyakarta, Indonesia‡

ABSTRACT: The objective of this article is to describe mathematics instruction, problems, challenges and opportunities in Manokwari Regency, Indonesia. The research was conducted for three years, from 2014 until 2017. There are nine senior high schools and 12 junior high schools in Manokwari, both private and public schools, which beca the objects of this research. The research method used is a case study, with interviews and observation technique. Interviews were conducted with students, the headmaster and teachers, to support the research results by using interview guides with several questions asked during the interview. The results indicate that the system of mathematics instruction in Manokwari is still the same as in most other regions in Indonesia. The mathematical thinking ability of students in mathematics learning is not well established. Mathematics learning in Manokwari in particular, and the province of West Papua in general, needs to be changed. The use of Indonesian realistic mathematics education (RME), should be considered to improve the quality of mathematics instruction in Manokwari.

INTRODUCTION

Mathematics is one of the most important subjects in the education system of Indonesia, and is studied at all levels of education in Indonesia, from elementary school to university. It is so, because mathematics is a necessary branch of knowledge required for students to support their learning success in the future [1]. Mathematics is also one of the tools of scientific thinking that are needed to develop the ability of logical, systematic and critical thinking of students [2]. Moreover, mathematics is required by everyone in daily activities [3]. Therefore, students need to have a good mathematical knowledge to face the future.

Recognising the importance of mathematics, both in the structuring of reason and the formation of attitudes, as well as in the use of mathematics, the increase in the mathematic score at each level of education should receive serious attention [4-6]. The mathematics score plays a significant role in determining the requirements of graduate students in Indonesia, because mathematics is one of the compulsory subjects that determine graduation in national examinations [3].

On the other hand, at this time, it is still found that many students' mathematics scores in schools at all levels are still lower than in other subjects [7-10]. The results of research by international agencies also show the same thing [9][11-13]. PISA survey results using mathematical literacy variables indicate that in 2012 the average position of students in Indonesia was ranked 64th out of 65 countries studied. The grade achieved by students in Indonesia was 375, while the highest score was obtained by students in Shanghai, China, 613 [12].

The PISA results in 2015 show a less significant difference. Indonesia is ranked 62nd out of the 70 countries surveyed, with a score of 386 [13]. The PISA reports indicate that Indonesian students' thinking ability in mathematics is currently deficient [12][13]. This fact also shows that students' thinking ability in Indonesia, especially those who study mathematics, is receiving insufficient attention.

Several factors cause weak thinking ability of students who learn mathematics, such as, for example, the mathematics learning system used. The complexity of studying mathematics increases with the advancement of progress in various fields, including advances in mathematics itself. Therefore, the current mathe cal knowledge is not the same as the mathematics learning that has been developed before. According to the NRC, all young Americans must learn to think hematically, and they must think mathematically to learn [14]. It implies that students who study mathematics must think mathematically, and they must think mathematically in learning. On the other hand, several types of research documented that the learning approach of realistic mathematics education (RME) has a significant role to enhance students thinking ability in learning mathematics [15-17]. Therefore, this learning system, and also the learning approach, should be applied to young people who study mathematics in Indonesia, especially in West Papua - one of the rural area in Indonesia.

Based on the problem outlined above, the researchers would like to present their research concerning three aspects. Firstly, they discuss the mathematics instruction system in West Papua. Secondly, they explain how the schools in West Papua are already applying the principles of mathematics teaching. Lastly, they describe how the students who study mathematics in West Papua have learned to think mathematically and to think mathematically in learning.

LITERATURE REVIEW

Mathematics instruction in Indonesia is still conventional and tends to be mechanistic [18]. The teaching of mathematics has not emphasised the development of reasoning, logic and students' thinking processes [19]. Mathematics teaching is dominated by the introduction of verbal formulas and concepts, without sufficient attention being given to the understanding of students [20]. Students just listen, then imitate or copy what the teacher gives without initiative. Students are not encouraged to develop their thinking skills. Students are not allowed or invited to optimise their potential, to develop their reasoning. The mathematics instruction is also considered to be too unstructured to develop student personalities. The direction is found to emphasise cognitive factors only, even though the development of character as part of life skills is the task of all subjects in school [21].

Siswono states that mathematics instruction is less concerned with the development of high order thinking skills, such as creative thinking and mathematics problem-solving in Indonesia [22]. In fact, these two capabilities are fundamental, because in everyday life, everyone is always faced with various problems that must be solved and it demands creative thinking to find solutions to the problems encountered [23]. Creative thinking and problem-solving skills enable students to overcome life's challenges.

Both opinions follow the view of Suastika, who states that based on the results of the current study, mathematical learning conditions in Indonesia tend to be teacher centred [24]. Other than that, students are poorly trained in solving open problems. In giving exercises, teachers only provide routine and closed type questions. Moreover, the evaluations place more emphasis on mastery aspects of teaching materials, while issues related to students' mathematics creativity are almost never touched.

Meanwhile, Hadi said that there are two aims of mathematics instruction in Indonesia [15]. The first thing is to prepare students to be able to face the changing world through practical work based upon a rational, critical, curious and honest attitude, and logical, efficient and effective reasoning. The second aim is to prepare students to be able to use mathematics and mathematical logic in their life and study. These two goals are not easy to realise. Most students who learned mathematics in Indonesia, fear mathematics and are mathematics phobic. They tend to skip classes and are happy when their mathematics teacher is not able to come to class. It implies that there is a low quality of mathematics education and student achievement [16].

METHOD

The research was conducted for three years, from 2014 until 2017. The method used in this research was a case study, with interviews and observation techniques. A case study according to Ary et al is a type of ethnographic research study that focuses on a single unit, such as one individual, one group, one organisation or one programme [25]. The goal is to arrive at a detailed description and understanding of the entity (the *case*). Case studies use multiple methods, such as interviews, observation and archives, to gather data. There are nine senior high schools and 12 junior high schools, private and public, in Manokwari, and those became the subjects of this research. Each school had at least one mathematics teacher who is the subject of investigation. Interviews were conducted with students, mathematics teachers, headmasters and pre-service mathematics teachers who engaged in field practice to support the results of the study.

Interviews were conducted using interview guides. Several questions were asked during the interviews. The students were asked about their preparation before learning mathematics in the classroom, about their activities in learning, and their attitude to the lessons and the mathematics teacher. The headmasters were asked about what they knew about their mathematics teachers, the learning methods used by the mathematics teachers, their attitude and the motivation of the mathematics teachers. The pre-service mathematics teachers were asked about how the mathematics teachers taught in the classroom and the responses of the students. Observation of the mathematics learning system implemented by the teachers occurred, while the teachers taught and through analysis of the lesson plans of pre-service mathematics teachers approved by the teachers. Secondary data were obtained from various sources, particularly from the ministries of education and culture.

RESULTS

Teacher Activities

Mathematics teachers began the lesson by greeting, presenting the learning objectives and connecting with previous experience. Sometimes, teachers advised about improving students' learning motivation. The time spent on this activity

was not very long, usually around 5 - 10 minutes. The main events presenting the subject matter were followed by the lesson.

In the main activities, all mathematics teachers in Manokwari were observed during their lectures. Mathematics teachers rarely used other teaching methods, except when conducting classroom action research. The teacher wrote the subject matter on the blackboard and at particular times, dictated it. Sometimes, the writing activity on the blackboard was done by a student. Lesson material presented the standard pattern; namely, presentation of formulas, examples of questions and practice questions, according to the textbooks used. At certain times, the teacher answered the student's questions, although sometimes in an unfriendly voice.

The lesson ended with the teacher giving out homework. Homework assigned consisted of 1 to 5 questions, taken from the textbook. The teachers rarely made up their own problems.

Student Activities

Students start their mathematics learning activity by waiting for the teacher to enter the classroom. Not infrequently they do their homework at school, while waiting for the arrival of teachers. Students who do homework at school only copy the work of friends. Students are delighted if the teacher is unable to teach. They are pleased, making a deafening scream. For the students, mathematics lessons are the scariest experience.

As teachers teach, students do not always pay attention to what the teacher says. In some of the schools studied, students tended to speak while the teachers were teaching, and sometimes some students fall asleep. It happened because the teacher's voice was not clear. Noise from outside the classroom was also the cause of students not seriously paying attention to what was being taught by the teacher. It has occurred because there was no teacher or the teacher was late for another class. Also, students did not understand the prerequisite material, while the teacher only pursued the material to be taught following the curriculum.

When given the exercise questions, the students answered the questions individually, because the teachers did not require students to work in groups. In general, most students were not directly able to do the questions. Only a small group of students could do it. Although they could not do questions, the students tended to be passive and did not try to ask the teachers and other students. Students in the group only copied the answers of teachers or other students. The activities of students who studied mathematics in some schools in Manokwari are shown in Figure 1.

Figure 1: Some of the activities of students who studied mathematics in Manokwari, West Papua.

Textbooks

There are six types of mathematics textbooks used by mathematics teachers in Manokwari. Three types of books are used by junior high school teachers and three types are used by high school teachers. However, each teacher used only one type of book, where the book was also owned by students. The mathematics teacher at Manokwari, in both junior and senior high schools, always used a student worksheet that was intended for students in learning. The student worksheet books used were books not developed by teachers.

The mathematics textbooks used by teachers in Manokwari are published books. Thus, the books used have good content validity, as they fall within the curriculum. However, in their teaching, some materials are not taught by the

teachers. The trigonometric material is a material that is not always taught by the teacher due to unreasonable limitations of teaching time.

Problems contained in the mathematics textbooks tend not to be developed to improve students' thinking skills. Most (96.35%) of the questions are based on Bloom's taxonomy and are grouped as a matter of C1, C2, and C3. Only a small part is a problem developed to increase critical and creative thinking ski Distribution of problems based on the cognitive domain of Bloom's taxonomy in mathematics textbooks is presented in Table 1.

Table 1: The problems distribution based on the cognitive domain of Bloom's taxonomy in mathematics textbooks.

No	Part of textbook	C1	C2	C3	C4	C5	C6
1.	Example of problems	21.31	24.81	11.69	1.13	0.73	0.33
2.	Practice of problems	10.66	12.41	5.89	0.56	0.37	0.16
	Total	35.52	41.35	19.48	1.88	1.22	0.55

DISCUSSION

Mathematics instruction in Manokwari, by educational experts is known as teacher-centred learning. There are some teacher-centred learning weaknesses. This knowledge tends to make students inact and not creative. The mathematics learning system in Manokwari must be changed following the development of mathematics learning in the world, especially changing the paradigm of mathematics education in Indonesia.

The standard of mathematics learning has changed from the teacher-centred learning (transfer of knowledge) into a new model of innovative learning (construction of knowledge) that puts students at the centre of learning activities. This new learning paradigm appreciates the differences between individuals, to seek the formation of learning societies in learning activities to ensure the implementation of the principle of education for all. The learning paradigm is known as student-centred learning.

In student-centred learning, also known as student-centred class, according to Jones [26], students do n depend on their teacher all the time, waiting for instructions, words of approval, correction, advice or praise. They value each other's contributions; they cooperate, learn from each other and help each other. When in difficulty or doubt, y do ask the teacher for help or advice, but only after they have tried to solve the problem among themselves. The emphasis is on working together, in pairs, in groups and as a whole class. Their teacher also helps them to develop their language skills.

To produce effective and efficient mathematics instruction, the mathematics teaching system in West Papua should be shifted from being a teacher-centred learning system to a student-centred learning. One of these student-centred learning systems is Indonesian realistic mathematics education (RME).

Hadi stated that RME is defined as domain-specific instructional theory, which offers guidelines for instruction that aims to support students in constructing or reinventing mathematics in problem-centred interactive activities [15]. ME was adopted from realistic mathematics education that was founded and developed in the Netherlands [17]. Realistic mathematics education is a domain-specific instruction theory for mathematics. The main characteristic RME is that rich, *realistic* situations are given a prominent position in the learning process. These conditions serve as a source for initiating the development of mathematical concepts, tools and procedures, and as a context in which students can apply their mathematical kn ledge at a later stage, which then gradually has become more formal and general and less context specific [27]. In RME, students should learn mathematics by developing and applying mathematical concepts and tools in daily-life problem situations that make sense to them [28]. Consequently, RME has considered improving the quality of mathematics instruction in West Papua.

CONCLUSIONS

Based on the results of research and discussion, it can be concluded that the system of mathematics instruction in Manokwari is still the same as in most regions in Indonesia. Mathematics learning in Manokwari is dominated by teachers. Teachers are the only source of learning and they use only one type of textbook. Education tends to be monotonous and boring, so students tend to be passive and do what the teacher instructs them to do. Mathematical thinking ability of students is not trained well in mathematics learning. Students are only taught to memorise the formula and use it in solving the given problem. Mathematics learning in Manokwari in particular, and the province of West Papu general, needs to be changed. The use of Indonesian realistic mathematics education (RME) should be considered in order to improve the quality of mathematics instruction in Manokwari.

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